FISH COLLECTIONS IN THE VICINITY OF LAKE OKONOKA, BELLE ISLE, MICHIGAN

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Sampling done on
May 17-19, 2015, May 15-17, 2019, and May 22-24, 2022

Introduction

This study was conducted as a pre- and post-survey of the fish community prior to construction of a channel to connect Lake Okonoka to the Detroit River, as well as before and after construction of a series of breakwalls to reduce turbulence from wave action and ship wakes. The survey area was from the fishing pier west of the Coast Guard station, to the point near the Yacht Basin. Sampling for each assessment was conducted over two consecutive nights, using standard gear for nearshore fish assessment. The weather was clear at the time of all sampling efforts with westerly winds from 10-20 mph. Sampling proceeded with no major difficulties. Timing of the sampling coincided with the muskellunge spawning time, as well as peak inshore migrations for many forage fishes and small game fishes. Typically, the largest inshore catches are taken in spring.

Methods

Sampling for the pre-existing fish community in the vicinity of the construction project near Lake Okonoka was conducted in May 2015. Sampling extended over three days, with nets initially set on the first day then retrieved on subsequent days. The initial plan was to set pairs of hoop nets and minnow trap gangs, and to seine and electroshock at

six distinct locations between the south fishing pier and the point immediately to the west. However, this was a fairly small area, and that much sampling could not be completed due to lack of space. As a result, hoop nets and minnow traps were set singly, starting at the fishing pier and then approximately every 100 yards between there and the point, for a total of six hoop nets and six minnow gangs in 2015. Similar methods were used in 2019, with four hoop nets and minnow trap gangs set – two in the area behind the breakwalls and two in the open area west of the breakwalls. In 2022, five hoop and minnow trap gangs were used, two in the area behind the breakwalls, two in the open area, and one in the outfall from Lake Okonoka. Electroshocking was conducted each year from the fishing pier to the point between the shore and five-foot depth. Seining was done twice in 2015, but the rocks and riprap made seining extremely difficult and it was abandoned after two hauls.

In physical characteristics, the area is very wave-swept, with predominant winds from the west causing waves along the shoreline on a regular basis, and the passage of freighters and other vessels causing wake to scour the shoreline as well. As a result, nearly the entire shoreline has been armored with rip-rap, and the habitat appears to be open sand, gravel, and clay on top of large rocks and concrete slabs. In fact, in emptying one seine while sitting on shore at the time of a freighter passage, we witnessed the water dropping approximately one foot prior to the freighter passing, and then raising approximately two feet from that level during the passage. As a result, there was much surge in the area during that passage and most probably during any other significant freighter passage. This was also evidenced in the nets, in which their lead or pot anchors were often displaced by currents, probably causing reduced fishing effectiveness at times. However, no such surge problems occurred with minnow traps or electroshocking.

In 2019, the breakwalls had been constructed near the fishing pier, and these reduced turbulence considerably. However, water level was very high at that time so waves still broke over the breakwalls and caused a reduced level of turbulence in that region. Even in 2022, waves still penetrated the breakwalls to create considerable turbulence, although less than in the open water area.

Hoop nets were set over a period of two nights, and minnow trap gangs with five baited minnow traps each were set over the same two-night period. In 2015, we walked the entire shoreline to decide where to seine, and then seined at the two locations where the nets could be pulled to shore without dealing with significant problems from rocks and other rip-rap. In 2019 and 2022, we could not seine due to high water levels and no shoreline available to pull up a seine. Finally, electrofishing was conducted throughout the entire study area, from near shore to a depth of approximately five feet.

The different nets and electroshocking were used because they collect different target species. Minnow traps are baited to attract minnows and other small fish, usually less than 3 inches in length. They can be set very close to shore and sample the shallow one- to two-foot depth area. Hoop nets are set from shore to a distance about 50 feet offshore, and fish that encounter the lead are displaced towards the hoop and retained

in the hoop structures. These can be small fish, but larger fish are also vulnerable to the net. Electroshocking can collect all sizes of fish, although small fish often pass through the capture net. Overall, different species are caught by the different techniques and the combination gives a robust means of understanding the fish community.

Results

2015

The region was poor fish habitat with relatively low abundances of fish estimated by any sampling method used. Our total fish collections (Tables 1 and 2) resulted in 1,010 fish taken by all methods combined, with the dominant species being emerald shiners (86% of the total composition), and with rock bass, yellow perch, and spottail shiners being other common species, collectively representing between 2-5% of the total collection. Most fish collected were either minnows or yearling game fish. Sampling in May prevented collection of young-of-year fish, which would not recruit to the gear for most species until fall. However, most of the fish collected were juveniles born the previous year.

Length information was collected on all game species taken in hoop nets or minnow traps to evaluate the size distribution of each species (Table 2). Most species represented a narrow size range, identified as probably one-year-old fish. A 610-mm Great Lakes musky was also collected, in addition to a 585-mm longnose gar, a 293-mm white bass, and a 308-mm northern pike. These game fish were adults, as were the largest yellow perch taken in this study (264 mm). The fish represented 14 species overall.

Previous collections have been done in the Detroit River system at different sites, mostly downstream in the Trenton Channel. Percent composition of different fish species for these collections is shown in Figure 1, as is the composition of different species in the current collection. There were significant differences between the expectation based on fish collected throughout the Detroit River and the species composition of the study area (x^2, $P < 0.05$). There were fewer spottail shiner, rock bass, largemouth bass, blacknose shiner, pumpkinseed, bluegill, and round goby than expected for the river in general, with far more emerald shiner and yellow perch than expected. Of course, some of these differences are simply location or species bias differences.

Most of the fish were taken by one seine haul in the middle of the study region. That haul produced over 800 of the 1,010 fish individuals collected. The haul was dominated by emerald shiner with a few other species, as well. In comparison to that haul, all other sampling attempts had very low productivity. For comparisons with the fish communities in 2019 and 2022, fish taken in seines were eliminated from the database.

Catch-per-unit effort was considerably lower than other sampling conducted in the Detroit River. A typical catch-per-unit effort for the same combination of nets in nearshore habitats with abundant wetland vegetation for the river was approximately 60 fish/night. Our catch-per-unit effort was approximately 5.5 fish/night. This low catch rate was consistent across all gear types, as relatively few fish were taken in any sampling technique, except the one seine haul. This area appears to have a depauperate fish fauna, with relatively few species compared to other locations and relatively low abundance of individuals.

2019

This sampling period was targeted to determine if the breakwalls had any effect on the fish populations. We did two sets of nets in the area behind the breakwalls and two in the area outside that protection. We also shocked the entire shoreline again.

Sampling by hoop net and minnow trap was much more effective this year than in 2015. Fourteen species were again collected, and only 172 individuals (but more than the 105 taken in nets and shocking in 2015), with many of the fish being adult sizes of game fishes. Compared to 2015, we did not collect white bass, bluegill, longnose gar, spotfin shiner, or bluntnose minnow, although none of these species represented more than 1% of the collections in 2015. In 2019, we collected hornyhead chub, white sucker, golden shiner, largemouth bass, and smallmouth bass that were not collected in 2015, and hornyhead chub were common, comprising 8% of the fish collected. Rock bass were the dominant species collected at 50% of the total catch (Table 3), much higher than in 2015 (Figure 2). Round goby also increased in relative abundance (from 0.8 to 10.5%). Another change from 2015 was collection of more adult game fish, with rock bass averaging 134 mm in size, as well as adult largemouth bass, pike, and muskellunge being collected. The two collections were significantly different in species relative abundances (chi-square, $p<0.001$).

Of more interest to this analysis is the difference between samples within and beyond the breakwalls. Electroshock surveys were similar in the two regions, with most fish taken near shore. This is not surprising, given that shocking tends to move fish into hiding locations where they are taken, and the only real hiding locations were in the nearshore area. Similarly, minnow trap collections were similar in the two areas, indicative of the traps collecting mainly small fish near shore where they are set. Conversely, hoop nets took far more rock bass in the breakwall area (64 compared to only 4 taken in the open region), and the only ones taken outside that area were young fish. It was clear in our sampling that the breakwalls had an effect on fishes found there, and that rock bass had quickly started to colonize this area as adults over the short time period the walls had been in place.

While the fish population appeared to increase in 2019, it was still limited compared to vegetated areas of the Detroit River. Our overall catch in 2019 was 8 fish per net night, still considerably below the 60 fish per net night for samples in vegetated areas, although it was almost twice the value for collections in 2019.

2022

This sampling period was targeted to determine if the outlet from Lake Okonoka, as well as the breakwalls, had any effect on the fish populations. We did two sets of nets in the area behind the breakwalls, one at the outfall, and two in the area outside that protection. We also shocked the entire shoreline again.

Sampling by hoop net and minnow trap was less effective this year than in 2019. It was difficult to set hoop nets at the outfall, as the current moved the gear around and sprung the nets, stopping their catching ability at some unknown time in the set. Additionally, a storm hit on the second night, springing 5 of the hoop nets and causing considerable mud on the minnow traps, probably also limiting catch. In spite of these difficulties, 20 species were collected, and 209 individuals, more than both other collections, and many of the fish were again adult sizes of game fishes (Tables 5 and 6). Compared to 2019, we did not collect hornyhead chub, northern pike, largemouth bass, golden shiner, blacknose dace, and muskellunge, although all of these species but hornyhead chub represented less than 1% of the collections in 2019. In 2022, we collected river redhorse, bluegill, common shiner, logperch, yellow bullhead, striped shiner, longnose gar, white bass, bluntnose minnow, pumpkinseed, white crappie, and freshwater drum, with river redhorse being the biggest change comprising 4.3% of the fish caught. Rock bass were the dominant species collected at 58% of the total catch (Table 3), similar to 2019 and higher than in 2015 (Figures 2 and 3). Round goby also declined dramatically in relative abundance (from 0.8% to 10.5% to 1.9%). Another change from 2015 was collection of more adult game fish in both 2019 and 2022, with rock bass averaging 125 mm in size, as well as adult bluegill, yellow perch, and white bass collected. The fish species abundance in 2022 (Figure 3) was significantly different from both the 2019 sample and the 2015 sample (chi-square, $p<0.001$).

Of more interest to this analysis is the difference between samples near the outfall. Hoop nets and minnow traps took more fish in 2019, although fewer sets were successful. But the biggest change was in the electroshock results. River redhorse and gar were collected exclusively by electroshock in the area near the outfall, and a fairly large number of river redhorse escaped the shocking due to the large number turned up at one time. We also missed a number of larger perch and one muskellunge in the area behind the breakwalls. Most of the fish taken in the area beyond the breakwalls were collected very near to the outfall, and probably represent fish that were still influenced by the breakwalls, while farther west collections took few fish. Minnow trap collections were similar in the two areas, indicative of the traps collecting mainly small fish near shore where they are set. Conversely, hoop nets took far more rock bass and sunfish in the breakwall area, and the only ones taken outside that area were young fish. It was clear in our sampling that the breakwalls had an effect on fishes found there, and that rock bass had quickly started to colonize this area as adults over the short time period the walls had been in place.

While the fish population appeared to increase in 2022, it was still limited compared to vegetated areas of the Detroit River. Our overall catch in 2022 was 17 fish per net night,

considerably below the 60 fish per net hour for samples in vegetated areas, and higher than the value for collections in 2019. If we correct these numbers by removing the nets that were sprung, then catch per net night increases to 22.7. Overall catch per net night in 2022 was highest for the three years of analyses, but lower than typical samples for other locations in the Detroit River.

Discussion

The overall sampling of the region near the fishing pier on Belle Isle in 2015 indicated very low abundance of mainly juvenile fish, and of those, predominantly minnows. The catch-per-unit effort was exceptionally lower than other sites throughout the Detroit River, and the species composition was devoid of many common species, especially juvenile game fishes. The area has limited habitat that could serve as a nursery for juvenile fishes and, as a result, has a very limited juvenile fish population. Adult fishes are also relatively uncommon, with only a few muskellunge, yellow perch, and white bass as representatives taken as adult sized game fishes. This was a marginal fish habitat that could be improved considerably by restoration.

In 2019, shortly after completion of the breakwalls, fish abundance had increased to roughly double that of 2015 and included a decent population of adult rock bass in the breakwall area. Species relative abundances had also changed, with far more rock bass, less emerald shiner, and more round goby and hornyhead chub. Abundance was still low compared to vegetated areas in the river. As the only change had been a short period of protection by the breakwalls, and no real change in vegetation abundance or sediments had occurred in the area, it might be expected that more fish will take up residence in the area after time has allowed for physical habitat changes.

In 2022, after completion of the outfall and flow through conditions in Lake Okonoka, the fish community showed changes again, with more redhorse and other species in the outfall area, more fish in the breakwall area, and an overall increase in fish abundance and species richness compared to earlier samples. Beyond the changes for the outfall area, the trend of increased abundance in rock bass and other game fish of adult ages in the breakwall area compared to the open area that was first noticed in 2019 continued into 2022.

It is important to note here that the amount of sampling done in the area limits extrapolation of these results. While trends in commonly caught fishes probably reflect real changes in the fish community, many of the species in all of the collections were represented by only 1 individual taken, and their presence or absence could easily be missed with the amount of sampling done. Changes in fish communities in river systems have been shown to occur annually, seasonally, and even daily in response to changing environmental trends in the location. But the overall effects of these restoration structures do appear to be positive for the fish community in the nearshore Detroit River.

Table 1. Sampling methods and durations for fish sampling, May 17-19, 2015, near Lake Okonoka, Belle Isle. Nets and traps numbered 1 were set in the easternmost locations, and the nets proceeded west by number.

Net Type	Number	Set Time	Pull time	Number of Fish	Number of Species
Hoop	1	5/17 14:58	5/18 11:13	4	1
Hoop	2	5/17 15:05	5/18 11:20	13	3
Hoop	3	5/17 15:11	5/18 11:38	1	1
Hoop	4	5/17 15:16	5/18 11:43	3	1
Hoop	5	5/17 15:19	5/18 11:49	4	2
Hoop	6	5/17 15:27	5/18 11:55	0	0
Minnow	1	5/17 16:50	5/18 12:36	2	12
Minnow	2	5/17 16:41	5/18 12:29	0	0
Minnow	3	5/17 16:34	5/18 12:23	0	0
Minnow	4	5/17 16:28	5/18 12:15	3	1
Minnow	5	5/17 16:22	5/18 12:10	2	1
Minnow	6	5/17 16:16	5/18 12:04	0	0
Hoop	1	5/18 11:13	5/19 12:47	3	3
Hoop	2	5/18 11:20	5/19 12:42	12	3
Hoop	3	5/18 11:38	5/19 12:36	4	3
Hoop	4	5/18 11:43	5/19 12:28	0	0
Hoop	5	5/18 11:49	5/19 12:15	3	1
Hoop	6	5/18 11:55	5/19 12:10	0	0
Minnow	1	5/18 12:36	5/19 14:01	3	1
Minnow	2	5/18 12:29	5/19 13:51	1	1
Minnow	3	5/18 12:23	5/19 13:44	0	0
Minnow	4	5/18 12:15	5/19 13:37	4	1
Minnow	5	5/18 12:10	5/19 13:31	4	2
Minnow	6	5/18 12:04	5/19 13:26	0	0
Seine	1	5/18 14:50		23	3
Seine	2	5/18 15:10		882	8
Electrofish	1	5/19 10:50	5/19 11:40	39	7
Total catch				1010	14
w/o seine				105	14

Table 2. Fish collection data from sampling, May 17-19, 2015, at Belle Isle. Numbers with asterisks include fish taken in seines, those below have seine catches removed.

Species	Common Name	Total Collected	Length Range (mm)	Mean Length (mm)
Notropis atherinoides	Emerald shiner	871*	63-82	73.8
		21		
Ambloplites rupestris	Rock bass	46*	63-194	91.2
		34		
Perca flavescens	Yellow perch	38*	63-264	141.9
		33		
Notropis hudsonius	Spottail shiner	23*		
		13		
Labidesthes sicculus	Brook silverside	15*	68-74	73.8
		10		
Neogobius melanostomus	Round goby	8	67-80	71
Lepomis macrochirus	Bluegill	2	71-93	82
Esox masquinongy	Muskellunge	1	610	610
Lepisosteus osseus	Longnose gar	1	585	585
Morone chrysops	White bass	1	293	293
Esox lucius	Northern pike	1	308	308
Cyprinella spiloptera	Spotfin shiner	1		
Moxostoma macrolepidotum	Shorthead redhorse	1		
Pimephales notatus	Bluntnose minnow	1		
TOTAL	**14**	**1010**		

Figure 1. Species composition of fish collected in the Detroit River in previous studies, compared to the composition of fish sampled in this analysis.

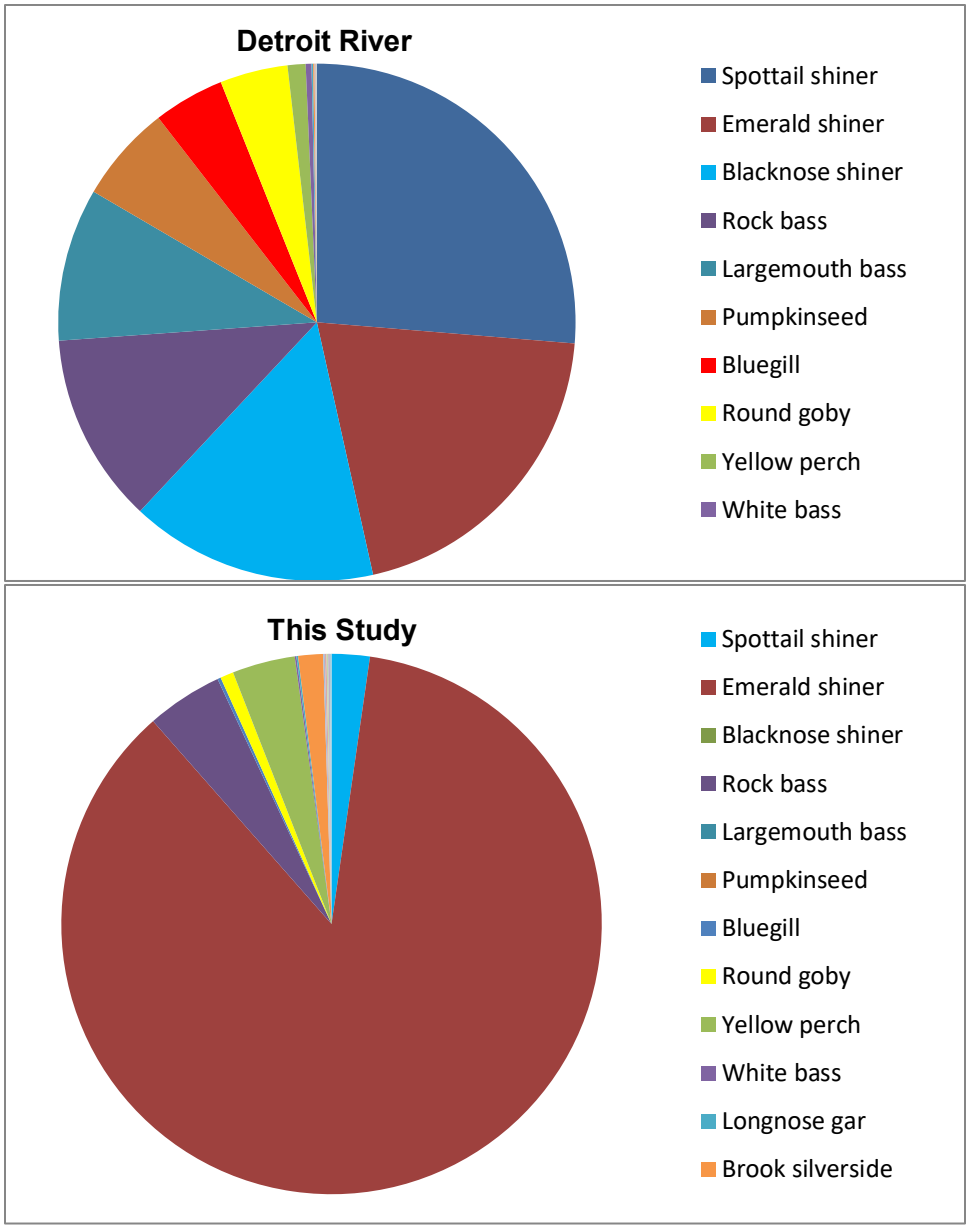


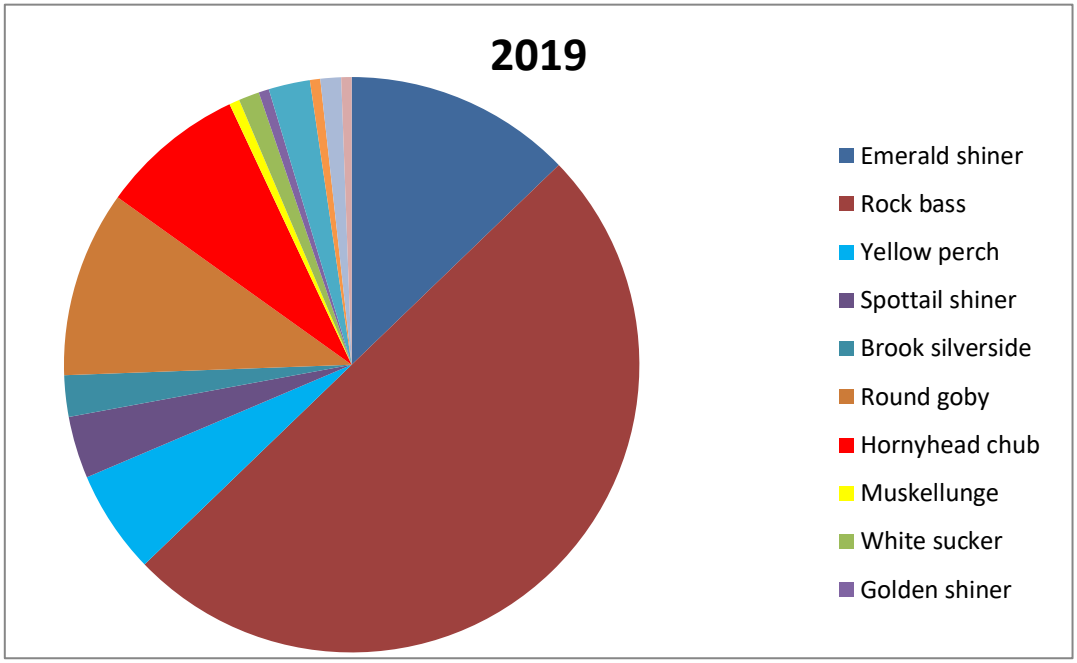
Table 3. Sampling methods and durations for fish sampling, May 15-17, 2019, near Lake Okonoka, Belle Isle. Nets and traps numbered 1 and 2 were set in the breakwall area, while those numbered 3 and 4 were outside this area.

Net Type	Number	Set Time	Pull time	Number of Fish	Number of Species
Hoop	1	5/15 13:13	5/16 10:00	26	1
Hoop	2	5/15 13:16	5/16 10:12	16	1
Hoop	3	5/15 13:22	5/16 10:19	0	0
Hoop	4	5/15 13:31	5/16 10:28	0	0
Minnow	1	5/15 13:56	5/16 10:34	0	0
Minnow	2	5/15 14:05	5/16 10:40	4	2
Minnow	3	5/15 14:11	5/16 10:47	5	2
Minnow	4	5/15 14:18	5/16 10:56	9	3
Hoop	1	5/16 10:00	5/17 12:47	3	3
Hoop	2	5/16 10:12	5/17 12:42	7	3
Hoop	3	5/16 10:19	5/17 12:36	5	3
Hoop	4	5/16 10:28	5/17 12:28	0	0
Minnow	1	5/16 10:34	5/17 9:25	3	1
Minnow	2	5/16 10:40	5/17 9:35	7	3
Minnow	3	5/16 10:47	5/17 9:40	1	1
Minnow	4	5/16 10:56	5/17 9:50	10	3
Electrofish	1	5/16 11:20	5/16 12:23	76	13
TOTAL				172	14

Table 4. Fish collection data from sampling, May 15-17, 2019, at Belle Isle.

Species	Common Name	Total Collected	Length Range (mm)	Mean Length (mm)
Ambloplites rupestris	Rock bass	86	44-241	133.9
Notropis atherinoides	Emerald shiner	22	63-82	73.8
Neogobius melanostomus	Round goby	18	67-80	71
Perca flavescens	Yellow perch	10	102-133	114
Nocomis biguttatus	Hornyhead chub	14		
Notropis hudsonius	Spottail shiner	6		
Labidesthes sicculus	Brook silverside	4	68-74	73.8
Esox Lucius	Northern pike	4	362-724	516
Micropterus salmoides	Largemouth bass	2	333	333
Catostomus commersoni	White sucker	2		
Notemigonus crysoleucas	Golden shiner	1		
Rhinichthys atratulus	Blacknose dace	1		
Micropterus dolomeiu	Smallmouth bass	1	95	95
Esox masquinongy	Muskellunge	1	1041	1041
TOTAL	**14**	**172**		

Figure 2. Species composition of fish collected during sampling in 2019 compared to 2015.



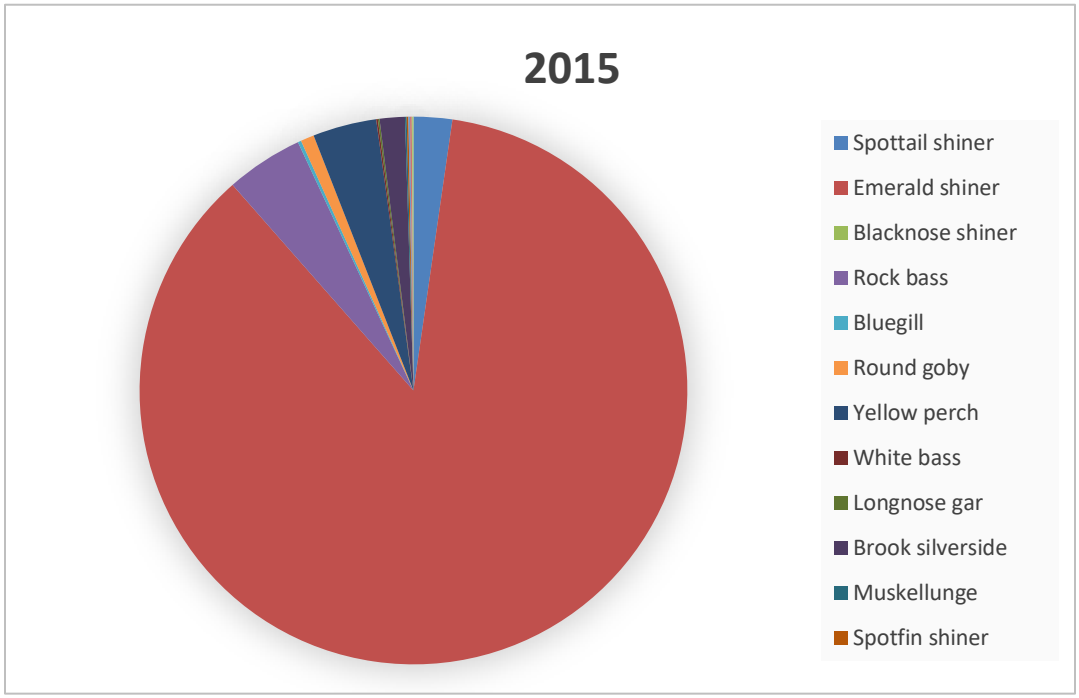


Table 5. Sampling methods and durations for fish sampling, May 22-24, 2022, near Lake Okonoka, Belle Isle. Nets and traps numbered 1 and 2 were set in the breakwall area, 3 and 4 in the open area, and 5 in the area of the outfall. Asterisks indicate nets that were sprung during sampling and did not sample the entire time period.

Net Type	Number	Set Time	Pull time	Number of Fish	Number of Species
Hoop	1	5/22/22 17:18	5/23/22 11:46	0*	0
Hoop	2	5/22/22 17:21	5/23/22 11:56	38	4
Hoop	3	5/22/22 17:30	5/23/22 12:42	6	2
Hoop	4	5/22/22 17:34	5/23/22 12:23	17	5
Hoop	5	5/22/22 17:40	5/23/22 12:13	0*	0
Minnow	1	5/22/22 17:50	5/23/22 13:30	24	3
Minnow	2	5/22/22 17:50	5/23/22 13:42	9	2
Minnow	3	5/22/22 17:58	5/23/22 14:03	11	2
Minnow	4	5/22/22 18:07	5/23/22 13:56	2	1
Minnow	5	5/22/22 18:03	5/23/22 13:49	8	3
Hoop	1	5/23/22 11:46	5/24/22 10:02	14	3
Hoop	2	5/23/22 11:56	5/24/22 10:10	10	4
Hoop	3	5/23/2212:42	5/24/22 13:37	4*	3
Hoop	4	5/23/2212:23	5/24/22 10:31	0*	0
Hoop	5	5/23/2212:13	5/24/22 10:21	2*	2
Minnow	1	5/23/2213:30	5/24/22 10:47	11	3
Minnow	2	5/23/2213:42	5/24/22 10:53	3	1
Minnow	3	5/23/2214:03	5/24/22 11:13	5	2
Minnow	4	5/23/2213:56	5/24/22 11:07	3	2
Minnow	5	5/23/2213:49	5/24/22 11:00	3	2
Electrofish	1	5/23/22 14:23	5/23/22 15:41	39	9
Total				209	20

Table 6. Fish collection data from sampling, May 22-24, 2022, at Belle Isle.

Species	Common Name	Total Collected	Length Range (mm)	Mean Length (mm)
Ambloplites rupestris	Rock bass	122	51-248	116.3
Perca flavescens	Yellow perch	28	83-267	163
Notropis atherinoides	Emerald shiner	16		
Moxostoma	River redhorse	9		
Lepomis macrochirus	Bluegill	5	108-216	138
Luxilus cornutus	Common shiner	5		
Percina caprodes	Logperch	4		
Neogobius melanostomus	Round goby	4		
Ameiurus natalis	Yellow bullhead	3		
Luxilus chrysocephalus	Striped shinier	2		
Notropis hudsonius	Spottail shiner	2		
Labidesthes sicculus	Brook silverside	1		
Catostomus commersonii	White sucker	1		
Lepisosteus osseus	Longnose gar	1		
Morone chrysops	White bass	1	420	420
Pimephales notatus	Bluntnose minnow	1		
Lepomis gibbosus	Pumpkinseed	1		
Pomoxis annularis	White crappie	1	127	127
Aplodinotus grunniens	Freshwater drum	1		
Micropterus salmoides	Smallmouth bass	1	165	165
TOTAL	**20**	**209**		

Figure 3. Species composition of fish collected during sampling in 2022 compared to 2019.